

AD-A105 022

KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA
NATIONAL DAM SAFETY PROGRAM. HARMAN'S FARM POND DAM (MO 30150);--ETC(U)
MAY 80 R J KIMBALL, J T HOCKENSMITH

F/G 13/13

DACW43-79-0034

UNCLASSIFIED

NL

1 of 1
AD A
105002

END
DATE
FILMED
10-81
DTIC

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AL 1155022

LEVEL II

①
BS

HARMAN'S FARM POND DAM

ST. FRANCOIS COUNTY, MISSOURI

MO 30150

DTIC
ELECTE
S **D**
OCT 0 6 1981
E

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION



United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

"Original contains color
plates: All DTIC reproduct-
ions will be in black and
white"

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

This document has been approved
for public release and sale; its
distribution is unlimited.

MAY 1980

81 10 2 181

FILE COPY

BS

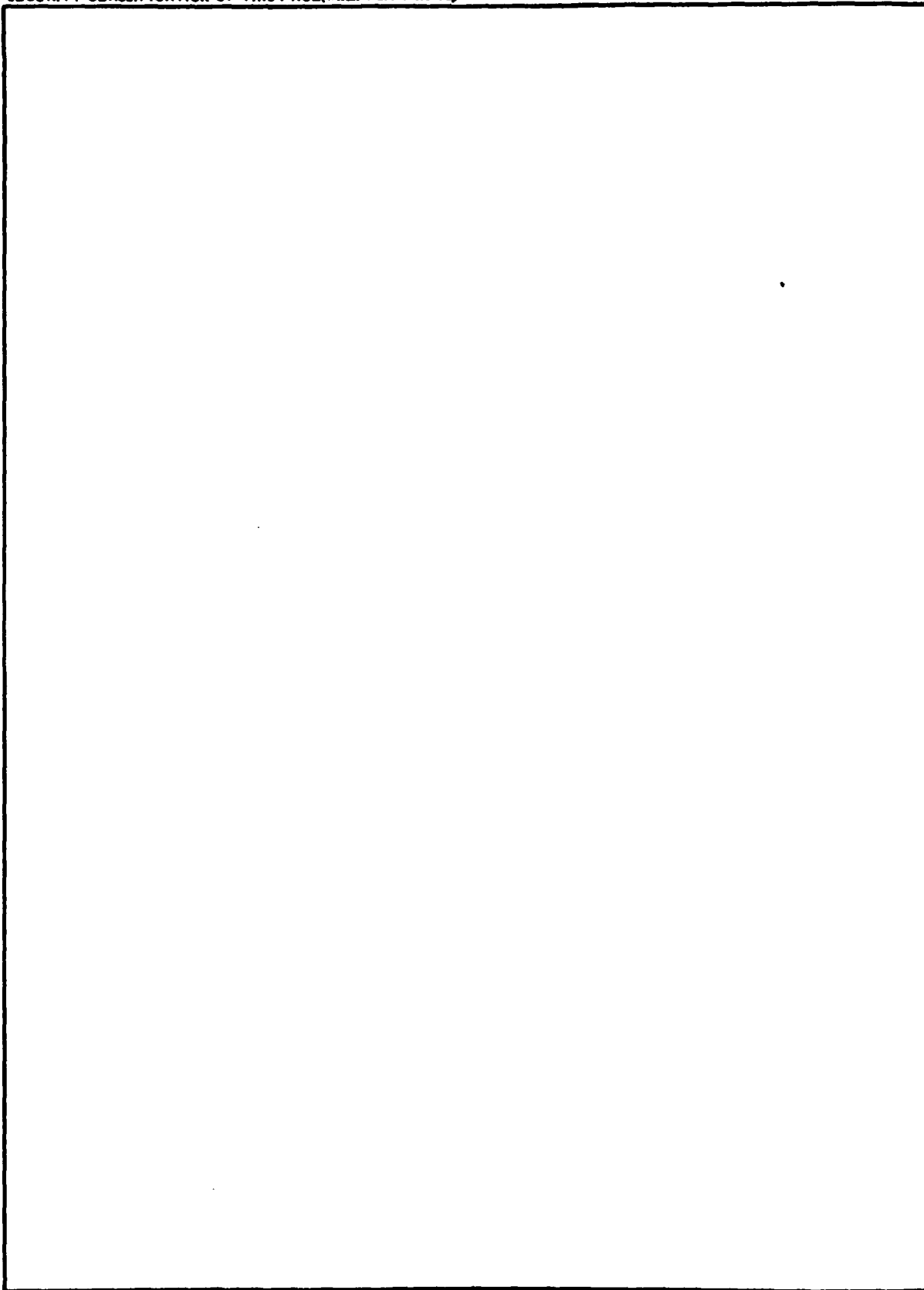
UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 022	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Harman's Farm Pond Dam (MO 30150) St. Francois County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report.
7. AUTHOR(s) L. Robert Kimball and Associates		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0034
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1.1.1
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (E) National Dam Safety Program. Harman's Farm Pond Dam (MO 30150), Mississippi Kaskaskia - St. Louis Basin, St. Francois County, Missouri. Phase I Inspection Report.		12. REPORT DATE 11 May 1980
16. DISTRIBUTION Approved for release; distribution unlimited.		13. NUMBER OF PAGES Approximately 45
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (10) 5-11-80		15. SECURITY CLASS. (of this report) UNCLASSIFIED
18. SUPPLEMENTARY NOTES		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

4/1057

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

RESPONSIBILITY. The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

C) CLASSIFICATION. Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data bases, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

COMPLETION GUIDE

General. Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

Block 1. Report Number. Enter the unique alphanumeric report number shown on the cover.

Block 2. Government Accession No. Leave Blank. This space is for use by the Defense Documentation Center.

Block 3. Recipient's Catalog Number. Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

Block 4. Title and Subtitle. Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title (see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT/E," AD-667 000). If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

Block 5. Type of Report and Period Covered. Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

Block 6. Performing Organization Report Number. Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

Block 7. Author(s). Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order (for example, John R. Doe or, if author prefers, J. Robert Doe). In addition, list the affiliation of an author if it differs from that of the performing organization.

Block 8. Contract or Grant Number(s). For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

Block 9. Performing Organization Name and Address. For in-house reports enter the name and address, including office symbol, of performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

Block 10. Program Element, Project, Task Area, and Work Unit Numbers. Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

Block 11. Controlling Office Name and Address. Enter the full, official name and address, including office symbol, of the controlling office. (Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents.")

Block 12. Report Date. Enter here the day, month, and year or month and year as shown on the cover.

Block 13. Number of Pages. Enter the total number of pages.

Block 14. Monitoring Agency Name and Address (if different from Controlling Office). For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

Blocks 15 & 15a. Security Classification of the Report: Declassification/Downgrading Schedule of the Report. Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification/downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

Block 16. Distribution Statement of the Report. Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 17. Distribution Statement (of the abstract entered in Block 20, if different from the distribution statement of the report). Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 18. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of (or by) . . . Presented at conference of . . . To be published in . . .

Block 19. Key Words. Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" (TEST), AD-672 000, can be helpful.

Block 20. Abstract. The abstract should be a brief (not to exceed 200 words) factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT/E," AD-667 000.

HARMAN'S FARM POND DAM
ST. FRANCOIS COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30150

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Code	
Avail and/or	
Dist	Special
A	

PREPARED BY

L. ROBERT KIMBALL AND ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS
EBENSBURG, PENNSYLVANIA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY 1980



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Harman's Farm Pond Dam Phase I Inspection Report

This report presents the results of field inspection and evaluations of Harman's Farm Pond Dam (MO. 30150).

This report was prepared under the National Program of Inspection of Non-Federal Dams.

Harman's Farm Pond Dam has been classified as unsafe, non-emergency by the St. Louis District because the spillway will not pass 50% of the PMF.

SUBMITTED BY: SIGNED 14 MAY 1980
Chief, Engineering Division Date

APPROVED BY: SIGNED 15 MAY 1980
Colonel, CE, District Engineer Date

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Harman's Farm Pond
STATE LOCATED	Missouri
COUNTY LOCATED	St. Francois
STREAM	Unnamed Tributary to West Fork
DATE OF INSPECTION	October 19, 1979

Harman's Farm Pond Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high-hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The dam is in the small size classification since it is greater than 25 feet high, but less than 40 feet high with a storage capacity less than 1000 acre-feet but more than 50 acre-feet. The estimated damage zone extends approximately 3/4 miles downstream of the dam. Within this damage zone are approximately 6 dwellings and Laguna Palma Dam (MO 30404).

Based on the downstream affected area the Spillway Design Flood for this dam is the PMF (Probable Maximum Flood). The spillway is capable of controlling approximately 21% of the PMF without overtopping the embankment. The ability of the spillway, at Harman's Farm Pond Dam, to pass the the 100 year storm is marginal.

Deficiencies visually observed for Harman's Farm Pond Dam include no riprap on the upstream slope, trees and brush on the embankment slopes and in the spillway, wet area at the toe of the embankment, two animal burrows and no means to drain the reservoir. There is neither a warning system in effect nor a safety inspection program. Stability and seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not available which is considered a deficiency. These deficiencies should be remedied at the direction of a professional engineer knowledgeable in the design and construction of earthfill dams. No deficiencies were observed regarding sliding, cracking, settlement or sinkholes. No seepage or erosion were noted during the inspection. Maintenance of the dam is considered poor.

HARMAN'S FARM POND DAM - MO. 30150

O.T. McConnell

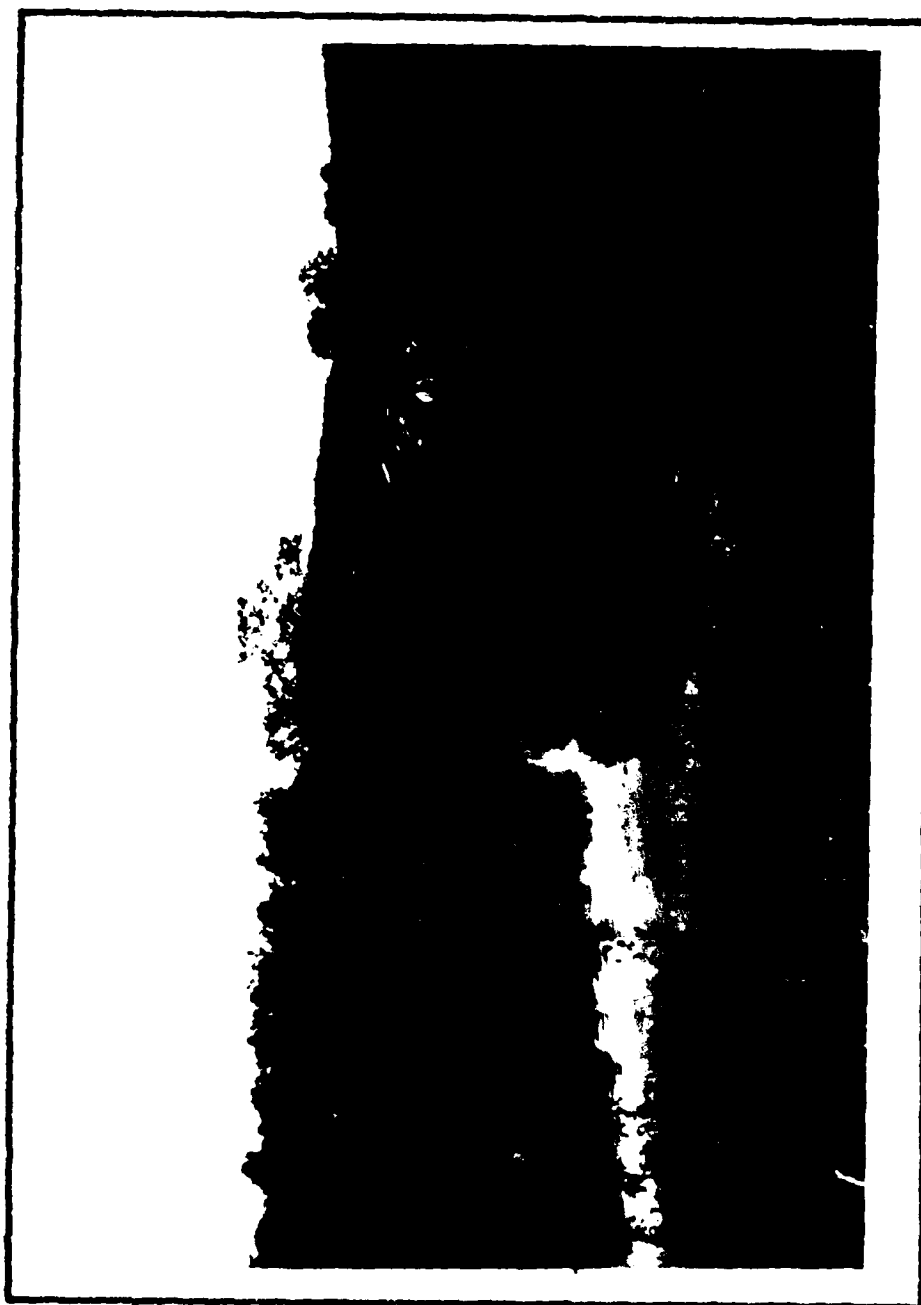
O.T. McCONNELL
Hydraulic Engineer

James T. Hockensmith

JAMES T. HOCKENSMITH
L. Robert Kimball & Associates
Geologist

R Jeffrey Kimball

R. JEFFREY KIMBALL, P.E.
L. Robert Kimball & Associates
Vice President, Earth Sciences



Photograph No. 1. Overview of upstream slope of dam.

TABLE OF CONTENTS

	PAGE
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	4
2.1 Design	4
2.2 Construction	4
2.3 Operation	4
2.4 Evaluation	4
SECTION 3 - VISUAL INSPECTION	5
3.1 Findings	5
3.2 Evaluation	7
SECTION 4 - OPERATIONAL PROCEDURES	8
4.1 Procedures	8
4.2 Maintenance of the Dam	8
4.3 Maintenance of Operating Facilities	8
4.4 Description of any Warning System in Effect	8
4.5 Evaluation	
SECTION 5 - HYDRAULIC/HYDROLOGIC	9
5.1 Evaluation of Features	9
SECTION 6 - STRUCTURAL STABILITY	11
6.1 Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES	12
7.1 Dam Assessment	12
7.2 Recommendations/Remedial Measures	12

LIST OF APPENDICES

APPENDIX A - DRAWINGS

APPENDIX B - HYDROLOGY AND HYDRAULICS

APPENDIX C - PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HARMAN'S FARM POND DAM - I.D. NO. 30150

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Harman's Farm Pond Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. Harman's Farm Pond Dam is an earthfill dam, approximately 342 feet long and 31.5 feet high. The embankment is a cross valley earthfill dam which impounds water to a normal elevation of approximately 650.7 feet. The upstream slope is unprotected against wave action (no riprap). The upstream slope varies from 2.5H:1V to 3H:1V. The downstream slope is 2.5H:1V. The crest width is 10 feet.

The spillway is located near the right abutment (viewing downstream). The spillway channel bottom at the control section is approximately 16 feet wide and is cut into bedrock. The control section is located approximately 25 feet downstream from the centerline axis of the dam. The control section is trapezoidal shaped with an average side slope of 1.5H:1V. Further downstream the side slopes of the spillway channel become almost vertical. There is no emergency spillway at Harman's Farm Pond Dam.

b. Location. Harman's Farm Pond Dam is located approximately 3.6 miles southeast of Valles Mines, Missouri on a tributary of the West Fork of Platten Creek. The dam can be located (Section 1, Township 38 North, Range 5 East) on the Halifax, Missouri 7.5 minute U.S.G.S. quadrangle.

c. Size Classification. Harman's Farm Pond Dam is a small size structure (31.5 feet high, 51 acre-feet).

d. Hazard Classification. Harman's Farm Pond Dam is a high hazard dam. Downstream conditions indicate that loss of life is probable should failure of the dam occur. The estimated hazard zone extends approximately 3/4 miles downstream of the dam. Within the hazard zone are 6 dwellings and Laguna Palma Dam (MO. 30404).

e. Ownership. Harman's Farm Pond Dam is owned by Mr. Morris Harman. Correspondence should be addressed to:

Mr. Morris Harman
9955 Mahogany Court
St. Louis, MO 63123
(314) 631-4010

f. Purpose of Dam. Harman's Farm Pond Dam is used for recreation.

g. Design and Construction History. Based on an interview with the owner's son, Mr. Chris Harman, who designed the dam, and a letter written by the owner, the dam was built in the spring of 1967. The owner reported that the dam was constructed by the H.F. Gegg Construction Company of Ste Genevieve, Missouri. No design drawings, reports or construction history exists.

h. Normal Operating Procedures. No operating records exist. During an interview with the owner's son, it was reported that the spillway is occasionally blocked. The spillway blockage is cleared with a tractor when needed.

1.3 PERTINENT DATA

a. Drainage Area. 0.26 square miles
U.S.G.S. quadrangle

b. Discharge at Damsite (cfs).

(1) Maximum known flood at dam site	Unknown
(2) Spillway capacity at top of dam	360

c. Elevation (feet) - Field survey based on assumed spillway crest elevation of 650.7 feet estimated from aerial photographs supplied by the St. Louis District, Corps of Engineers and U.S.G.S. 7.5 minute Halifax quadrangle.

(1) Top of dam (low spot)	654.1
(2) Spillway crest	650.7
(3) Normal pool	650.7
(4) Maximum pool (PMF)	656.5
(5) Tailwater on day of inspection	None
(6) Streambed at centerline of dam	622.5

d. Reservoir (feet).

(1) Length of maximum pool	1200
(2) Length of normal pool	1000

e. Storage (acre-feet).

(1) Top of dam	70
(2) Spillway crest	51
(3) Normal pool	51
(4) Maximum pool (PMF)	85

f. Reservoir Surface (acres).

(1) Top of dam	6
(2) Spillway crest	5
(3) Normal pool	5
(4) Maximum pool (PMF)	7

g. Dam.

(1) Type	Earthfill
(2) Length	342 feet
(3) Height	31.5 feet
(4) Top width	10 feet
(5) Side slopes	Upstream - 2.5H:1V to 3H:1V Downstream - 2.5H:1V

h. Spillway.

(1) Type	Open Cut
(2) Length (bottom)	16 feet
(3) Crest elevation	650.7 feet
(4) Upstream channel	Open cut in earth and rock
(5) Downstream channel	Open cut in rock to unnamed tributary
(6) Control Section Shape	Trapezoidal

i. Drawdown Facilities.

None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. No design drawings, reports or data are known to exist as reported by the owner.

2.2 CONSTRUCTION. Based on information supplied by the owner's son it was reported that the dam was built in the spring of 1967. No information exists on the construction of the dam.

2.3 OPERATION. No operating records exist.

2.4 EVALUATION.

a. Availability. There are no engineering data available.

b. Adequacy. The field surveys and visual inspection presented herein are considered adequate to support the conclusion of this report. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The onsite inspection of Harman's Farm Pond Dam was conducted by personnel of L. Robert Kimball and Associates on October 19, 1979. The inspection team consisted of a hydrologist, structural/soils engineer and a geologist. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments, and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.

b. Project Geology. The bedrock underlying Harman's Farm Pond Dam consists primarily of the Roubidoux formation which is part of the Candian series of the Ordovician System. The Gasconade formation underlies the Roubidoux formation and probably forms the rock under the dam itself.

The Roubidoux formation contains sandstone, dolomitic sandstone and cherty dolomite. Except in the central part of the state, the sandstone accounts for little more than 10% of the formation, the remainder consisting mostly of cherty dolomite. The dolomite is light to gray to brown, finely crystalline, and thinly to thickly bedded. The Roubidoux formation ranges in thickness from 100 to 250 feet, but is probably thinner here, since much of it has been eroded away.

The Gasconade is primarily a light brownish-gray cherty dolomite in this area. The lower part of the dolomite is coarsely crystalline and chert often makes up more than 50% of the volume of the rock. The upper part of the dolomite, which is present around Harman's Farm Pond, is finely crystalline and contains much smaller amounts of chert. The chert may be white and porcelain-like or with brown and gray bands. Many of the nearly vertical cliffs in the central Ozarks are formed by the Gasconade. Springs and caves are also common in this formation, which may be from 300 to 700 feet thick.

Only one rock outcrop was observed during the inspection. This was at the discharge end of the spillway and consisted of cherty dolomite. This may be either the Upper Gasconade or the lower Roubidoux. The rock was slightly weathered and exhibited some jointing while the beds were of medium thickness. Solution cavities are often found in these rock types, but no evidence of karst terrain was observed in the vicinity. It is difficult

to distinguish any more detailed information on the basis of one brief inspection with only one outcrop. The published literature contains only minimal information concerning these two formations.

Structural features in the vicinity of Harman's Farm Pond Dam include the Platin Creek anticline, the axis of which passes the lake immediately to the west in a northeast-southwest direction. The axis plunges gently northwards. The eastern limb is slightly steeper, but both limbs are reported as gently dipping (no dips are given). The Rugley School fault block and fault are another structural feature lying two to three miles south of the lake. A component of the Valles Mines - Vineland fault zone which is, in turn, a part of the Ste. Genevieve fault system, the Rugley School fault is the largest of a series of faults bounding the Rugley School fault block. This is an untilted wedge of sediment marked by faults on the northwest, north and northeast. To the south, however, it merges with the Farmington anticline. The Rugley School fault brings the Davis Shale into contact with Gasconade Dolomite while the other faults have small displacements of only about 75 feet. Some seismic activity is still noted in this part of the state.

c. Dam and Spillway. The visual inspection of the dam indicated that the embankment structure was in fair condition.

From a brief survey conducted during the inspection, it was determined that a low point on the dam is at elevation 654.1. The earth embankment section of the dam generally rises from the spillway section toward the left abutment. The earth embankment section is 342 feet long with a maximum height of approximately 31.5 feet. The upstream slope varies from 2.5H:1V to 3H:1V. The crest width is approximately 10 feet. The downstream slope is approximately 2.5H:1V. The downstream slope is covered with tall grass, weeds, briars and small trees. No seepage or erosion was noted on the downstream slope although two burrows were seen as well as a small water pool at the toe of the embankment. No discharge was visible from the pool during the inspection (See Figure 1 for location).

The spillway is located on the right side of the earthen embankment and is an open cut channel with the bottom cut into bedrock. The spillway and control section is trapezoidal and the exit channel is an open channel cut into bedrock. Spillway discharges cascade over bedrock outcrops beyond the toe of the dam (See Photos No. 8, No. 9). Brush and scattered trees line the spillway and exit channel slopes. There are no drainlines present to lower or drain the reservoir.

d. Reservoir Area. No obvious problems were noted in the reservoir area. The watershed is moderately sloped and wooded.

e. Downstream Channel. The downstream channel is a tributary of the West Fork and travels approximately 500 feet before joining the West Fork of Platten Creek. Laguna Palma Dam (MO. 30404) lies approximately 3/4 of a mile downstream of Harman's Farm Pond Dam on West Fork.

3.2 EVALUATION. The visual inspection did not reveal any immediate signs of instability. The earth embankment appears to be in fair condition. Both the upstream and downstream slopes are moderate and vegetated. No visible erosion exists and no seepage was noted although a small pond was present at the toe of the dam (See Figure 1). No discharge was detected from the ponded water.

A complete evaluation of the structure cannot be made without a detailed stability and seepage analysis.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES. The reservoir is maintained at or below the spillway crest elevation. No facilities are present to lower or drain the reservoir.

4.2 MAINTENANCE OF DAM. Maintenance of the dam is considered poor. Maintenance in the form of clearing occasional debris from the spillway is conducted when necessary by the owner.

4.3 MAINTENANCE OF OPERATING FACILITIES. No operating facilities are present to be maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT. The owner, reported that no warning system is in effect.

4.5 EVALUATION. Maintenance of the dam is considered poor. There is no warning system in effect to warn downstream residences of large spillway discharges or failure of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. There are no hydraulic or hydrological design data available as discussed in Section 2.

b. Experience Data. Information concerning drainage areas, and watershed characteristics, and storage were obtained from the U.S.G.S. topographic quadrangle. The spillway and dam layout was made from surveys conducted during the inspection. There is no history of the dam having been overtopped.

c. Visual Observations. The spillway is located at the right abutment of the embankment (viewing downstream). The spillway control section is trapezoidal in shape with a bottom width of 16 feet. The spillway exit channel is cut into rock and ultimately outlets over a rock outcrop beyond the toe.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, St. Louis District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydraulic Engineering Center (HEC) U.S. Army Corp of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed in Appendix B.

Complete summary sheets for the computer output are presented in Appendix B. To facilitate review, the major results of the overtopping analysis are presented below:

Peak inflow	3142	cfs
Spillway capacity	360	cfs

Ratio of PMF	Maximum Reservoir Water Surface (ft)	Maximum Depth over Dam (embankment) (ft)	Maximum Outflow, (cfs)	Duration of over topping, (hrs.)
.10	652.69	0.00	153	0.00
.20	654.03	0.00	348	0.00
.30	654.86	0.76	688	0.67
.50	655.60	1.50	1437	1.17
1.00	656.56	2.46	3110	5.17

The Corps of Engineers Spillway Design Flood for a high hazard-small dam is 1/2 PMF to the PMF. Based on the downstream hazard exposure, the Spillway Design Flood for this dam has been selected to be the PMF. The spillway is capable of controlling only approximately 21% of the PMF without overtopping the embankment. Overtopping the embankment for an extended period of time or with depth will cause failure of the dam.

Because of the low spillway capacity, the 100 year storm was routed through the reservoir. It was determined that the spillway is marginally capable of passing the 100 year storm. For the 100 year storm routing the dam was overtopped by 0.11 feet.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations indicate that the dam was in fair condition. No erosion or seepage was noted on the embankment during the inspection. The embankment slopes are moderate and covered with grasses. Ponded water was present at the toe near the right abutment (See Figure 1).

b. Design and Construction Data. No design or construction data is available on the dam. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

c. Operating Records. No operating records are kept on the structure.

d. Post Construction Changes. No post-construction changes are known for this structure.

e. Seismic Stability. The dam is located in seismic zone 2 to which the guidelines assign a "moderate" damage potential. No seismic stability analysis has been conducted.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The visual observations, review of available data and hydrologic calculations indicate that Harman's Farm Pond Dam's spillway is inadequate. The spillway is capable of controlling approximately 21% of the PMF without overtopping the embankment. In addition, the spillway is marginally capable of controlling the 100 year storm.

The earth embankment appeared to be in fair condition. No erosion or seepage was noted at the time of inspection. A heavy growth of weeds, briars and small trees was noted on the downstream slope. Ponded water was present at the toe of the dam near the right abutment, although no discharge was visible from the area. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

b. Adequacy of Information. Complete assessment of the structural stability of the structure cannot be made because of the limited design data and construction data. Stability and seepage analyses comparable to the requirement of the "Recommended Guidelines for Safety Inspections of Dams" were not available, which is considered a deficiency.

c. Urgency. The deficiencies described herein should be corrected promptly. Special note should be made of items in paragraph 7.2 a and b. and these recommendations should be pursued promptly.

d. Need for Phase II. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required, however a Phase II investigation is not required.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives. A detailed hydraulic and hydrology study should be conducted by a registered professional engineer knowledgeable in dam design to increase the spillway capacity. The study should begin immediately and remedial modifications begun immediately after the study is complete.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended:

1. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

2. The trees and brush which are located on the downstream slope, of the dam should be removed and the animal burrows filled. In addition, the brush and trees located in the spillway should be removed. Clearing of trees and brush from the embankment and spillway should be completed under the direction of a professional engineer experienced in the design and construction of dams.

3. Riprap should be provided on the upstream slope of the dam.

4. Positive drainage should be provided to eliminate the ponded water at the toe of the dam. If the seepage exists, it should be monitored at regular intervals and checked for turbidity (uncontrolled seepage can lead to a piping condition which could result in failure of the dam).

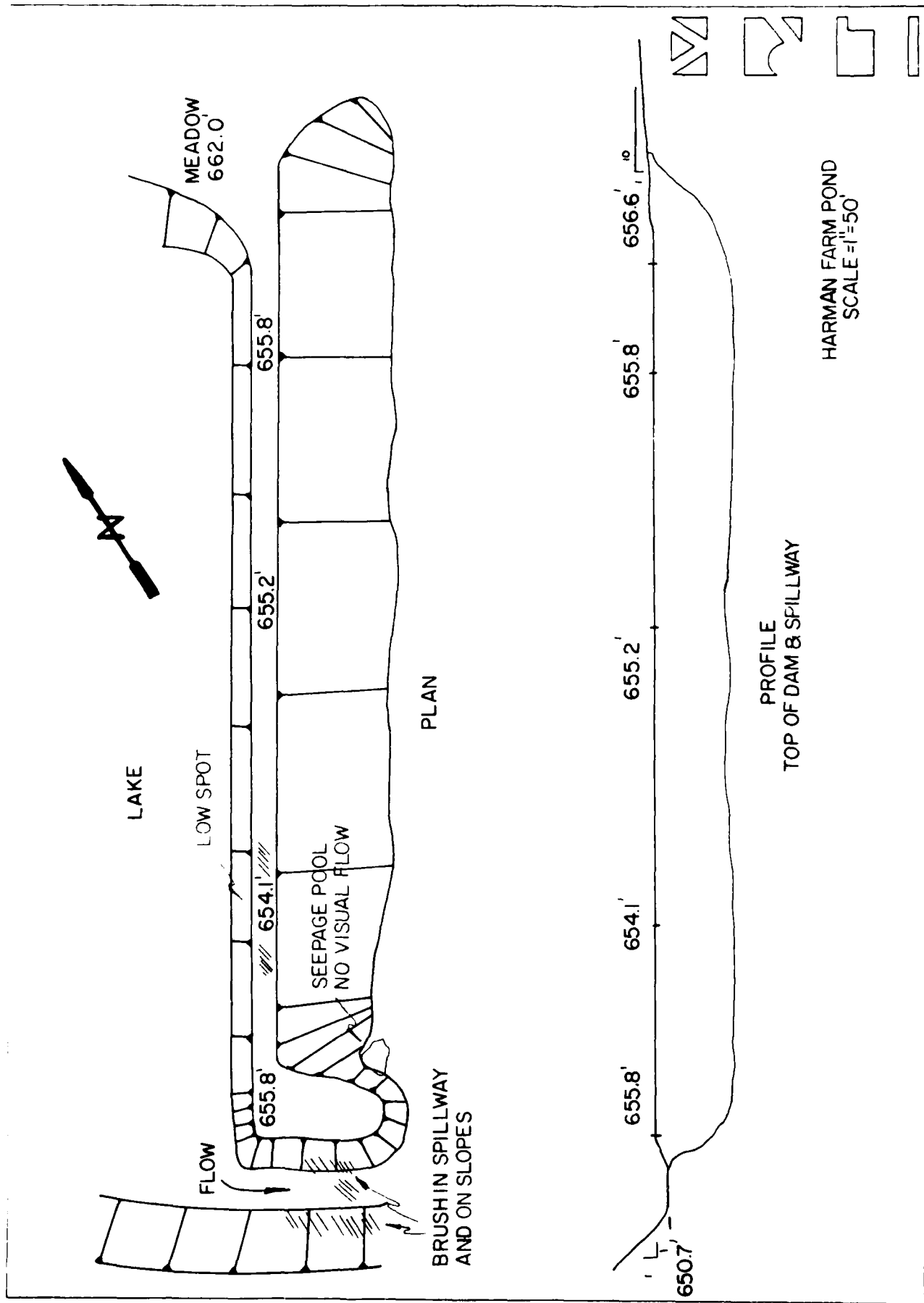
5. A means of draining the lake and regulating the reservoir surface should be provided.

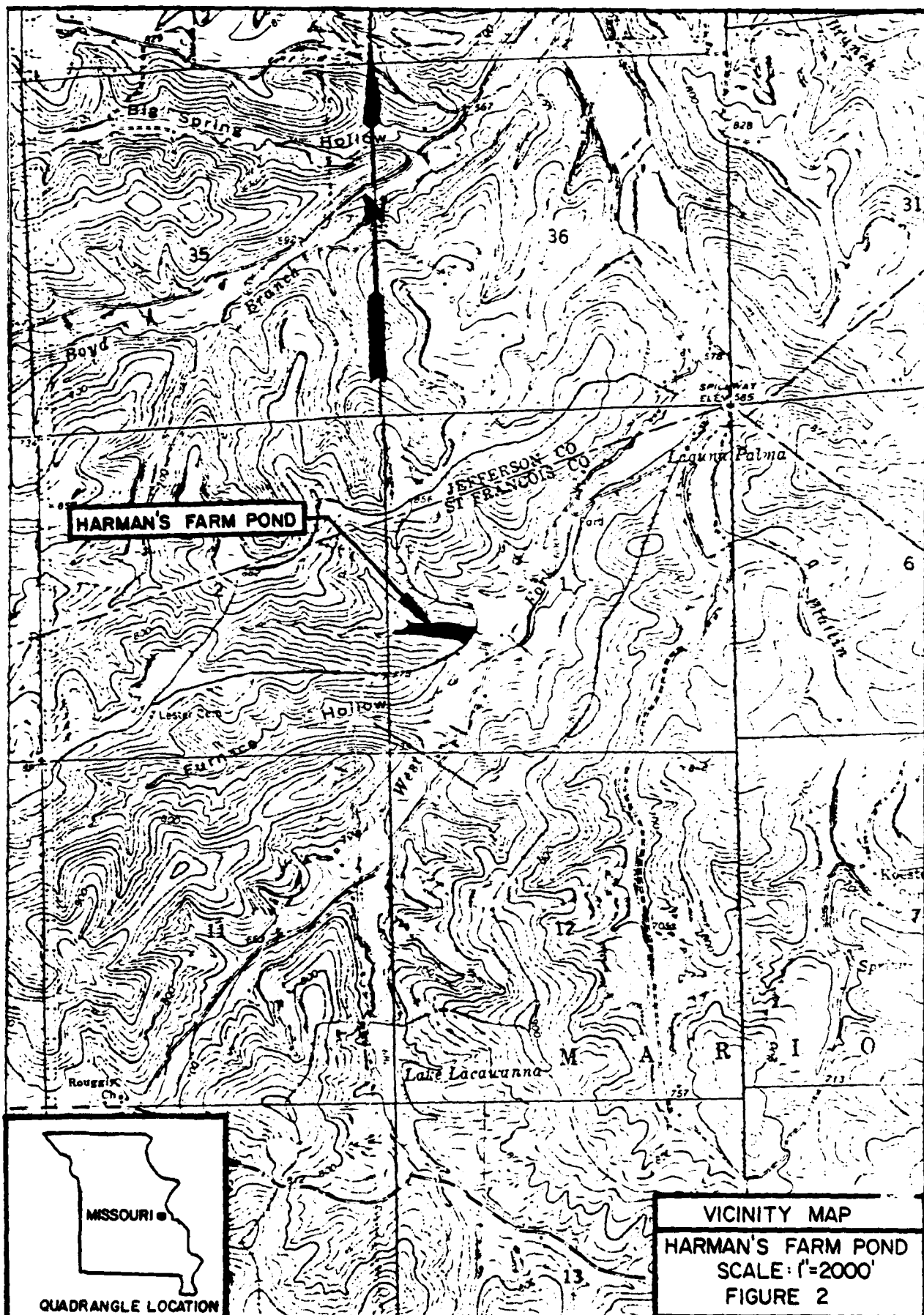
6. Institute a formal inspection program to be conducted at regular intervals by a registered professional engineer knowledgeable in earth dams. Records of all inspections and remedial actions should be kept and made available if necessary.

7. Institute a formal warning system to warn downstream residences of high spillway discharges or failure of the dam.

APPENDIX A

DRAWINGS





APPENDIX B

HYDROLOGY AND HYDRAULICS

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions.

The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillways, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillways, and top of dam are defined by elevation-discharge curves.

Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

The above analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow hydrograph was routed through the reservoir using HEC-1's Modified Puls option.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND

I.D. NUMBER 30/50

SHEET NO. 1 OF 4

BY OTM DATE 11-13-79

HARMAN'S FARM POND

DRAINAGE AREA

AREA = 0.26 SQ. MILES (U.S.G.S. 7.5-MIN. QUAD.)

UNIT HYDROGRAPH PARAMETERS

KIRPICH METHOD:

$t_c = 0.23$ HRS. $LAG = 0.6 t_c = 0.16$ HRS.

(FROM TIME OF CONCENTRATION NOMOGRAPH,
KENTUCKY BUREAU OF HIGHWAYS)

WHERE LENGTH = 4000 FT AND HEIGHT = 230 FT.

CURVE NUMBER METHOD:

$$LAG(L) = \frac{L^{0.8} (S+1)^{0.7}}{1900 Y^{0.5}} = \frac{(4,000)^{0.8} (3.82)^{0.7}}{1900 (6)^{0.5}}$$

$$= \frac{(761.5)(2.56)}{(4654)} = 0.42 \text{ HRS.}$$

WHERE L = GREATEST FLOW LENGTH IN FEET.

$S = \frac{1000}{CN} - 10$ AND Y = AVERAGE SLOPE

(FROM NATIONAL ENGINEERING HANDBOOK, HYDROLOGY:
SECTION 4 P. 15-7)

NOTE:

UTILIZED ANTECEDENT MOISTURE CONDITION III

HYDROLOGIC SOIL GROUP B

CN = 78

USE $t_c = 0.16$ HRS.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND

I.D. NUMBER 30150

SHEET NO. 2 OF 4

BY O.T.M. DATE 11-13-79

LOSS RATE AND BASE FLOW

STRTL = 1.0 INCH
CNSTL = 78
STRTQ = 1.5 CFS/MI²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.5

PROBABLE MAXIMUM STORM

FROM H.R. No. 33

P.M.P. INDEX RAINFALL (ZONE 1) = 25.5 INCHES
R₆ = 102%, R₁₂ = 120%, R₂₄ = 130%

ELEVATION-AREA-CAPACITY RELATIONSHIP

SPILLWAY CREST ELEV. = 650.7'
WATER LEVEL ASSUMED TO BE AT ELEV. 650.0'
(BASED ON AERIAL PHOTOGRAPHS SUPPLIED BY
THE ST. LOUIS DISTRICT C.O.E. AND U.S.G.S.
7.5-MIN. QUAD.)

ELEV. 650.7'	AREA = 5 AC.	} ESTIMATED FROM U.S.G.S. 7.5-MIN. QUAD.
ELEV. 660.0'	AREA = 7.5 AC.	
ELEV. 680.0'	AREA = 10 AC.	

FROM CONIC METHOD FOR RESERVOIR VOLUME.
FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM
SAFETY VERSION (USER'S MANUAL)

$$H = 3V/A = 3(51)/5 = 30.6'$$

∴ ELEV WHERE AREA EQUALS ZERO;
650.7' - 30.6' = 620.1' (USE 620')

WHERE VOL. (AC-FT) = 51 AC-FT (ESTIMATED)



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND

I.D. NUMBER 30150

SHEET NO. 3 OF 4

BY A.T.M. DATE 11-13-79

ELEV. - AREA - CAPACITY CONTINUED :

\$A	AREA (FT.)	0	5	7.5	10
\$E	ELEV. (FT.)	620'	650.7	660	680

SPILLWAY RATING CURVE

$$Q = 8.03 C' h_v^{1/2} (h_p - h_v) [B + Z (h_p - h_v)]$$

$$\text{WHERE } h_v = \frac{3(2Zh_p + B) - (16Z^2h_p^2 + 16ZBh_p + 9B^2)^{1/2}}{10Z}$$

AND $C' = 0.95$, $B = 16'$, $Z = 1.5$

FROM LOW DAMS, BY NATIONAL RESOURCE COMMITTEE
WASHINGTON, D.C. (1938)

WATER AND WASTEWATER ENGINEERING (11-1415)
BY FAIR, GEYER & OKUM (1966)

ELEVATION (FT.)	h_p (FT.)	DISCHARGE [*] (Q) (CFS)
650.7	0	0
651.0	0.3	10
651.5	0.8	40
652.0	1.3	80
652.5	1.8	130
653.0	2.3	190
653.5	2.8	260
654.1	3.4	360
656.0	5.3	770
660.0	9.3	2150

* DISCHARGE VALUES ROUNDED TO NEAREST 10 CFS.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBensburg PENNSYLVANIA

DAM NAME HARMAN'S FARM POND
I.D. NUMBER 30150

SHEET NO. 4 OF 4
BY OTM DATE 11-13-79

OVERTOPPING PARAMETERS

DISCHARGE DETERMINED BY H.E.C.-1.

TOP OF DAM (LOW SPOT) = 664.1'

LENGTH OF DAM (EXCLUDING SPILLWAY) = 342'

COEFFICIENT OF DISCHARGE = 3.0 (BROAD CREST WEIR)

L MAX. = 800'

V MAX. = 680'

2/10

FLOOD HYDROGRAPH PACKAGE (FHC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE: 79/11/01
TIME: 05:50:46

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HARMANS FARM POND DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (MISSOURI-301501)

JOB SPECIFICATION

NQ	NUR	NMIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	JWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED

PLAN	NRATIO	NRATIO
1	0.30	0.90

SUB-AREA RUNOFF COMPUTATION

INELW

ISTAD	JCOMP	RECON	ITAPE	JPLT	JPKT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

HYDGS	IUNG	TAHGA	SNAP	IRSDA	IRSPS	RAIO	ISNM	ISAME	LOCAL
1	2	0.26	0.00	0.26	1.00	0.000	0	1	0

PHCLIP DATA

SPFE	PMS	R6	M12	R24	R48	R72	R96
0.00	25.50	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STMR	DLTK	RTIOL	THAIN	SINKS	RTIOL	STIOL	CNGL	ALSHK	RTIMP
0	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -78.00 WFTNESS = -1.00 EFFECT (N = 78.00)

UNIT HYDROGRAPH DATA

TC	Q	Q	Q
1.0	0.00	0.00	0.00

RECESSION DATA

STRTQ	Q	Q	Q
1.0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT HYDROGRAPH DATA

MO-DA	HR-MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLUM COMP U	MO-DA	HR-MN	PERIOD	RAIN	EXCS	LOSS	COMP O
1.01	1.01	1	.01	0.00	.01	0	1.01	12.09	149	.22	.19	.03	1394
1.01	1.01	2	.01	0.00	.01	0	1.01	12.10	149	.22	.19	.03	219
1.01	1.01	3	.01	0.00	.01	0	1.01	12.11	149	.22	.19	.03	204
1.01	1.01	4	.01	0.00	.01	0	1.01	12.20	148	.22	.19	.02	341
1.01	1.01	5	.01	0.00	.01	0	1.01	12.25	149	.22	.19	.02	365
1.01	1.01	6	.01	0.00	.01	0	1.01	12.30	150	.22	.19	.02	378
1.01	1.01	7	.01	0.00	.01	0	1.01	12.35	151	.22	.19	.03	386
1.01	1.01	8	.01	0.00	.01	0	1.01	12.40	152	.22	.19	.03	391
1.01	1.01	9	.01	0.00	.01	0	1.01	12.45	153	.22	.19	.03	394
1.01	1.01	10	.01	0.00	.01	0	1.01	12.50	154	.22	.20	.02	397
1.01	1.01	11	.01	0.00	.01	0	1.01	12.55	155	.22	.20	.02	399
1.01	1.01	12	.01	0.00	.01	0	1.01	13.00	156	.22	.20	.02	401
1.01	1.01	13	.01	0.00	.01	0	1.01	13.05	157	.22	.20	.02	411
1.01	1.01	14	.01	0.00	.01	0	1.01	13.10	158	.22	.20	.02	436
1.01	1.01	15	.01	0.00	.01	0	1.01	13.15	159	.22	.20	.02	480
1.01	1.01	16	.01	0.00	.01	0	1.01	13.20	160	.22	.20	.02	475
1.01	1.01	17	.01	0.00	.01	0	1.01	13.25	161	.22	.20	.02	483
1.01	1.01	18	.01	0.00	.01	0	1.01	13.30	162	.22	.20	.02	488
1.01	1.01	19	.01	0.00	.01	0	1.01	13.35	163	.22	.20	.02	491
1.01	1.01	20	.01	0.00	.01	0	1.01	13.40	164	.22	.20	.02	493
1.01	1.01	21	.01	0.00	.01	0	1.01	13.45	165	.22	.20	.02	496
1.01	1.01	22	.01	0.00	.01	0	1.01	13.50	166	.22	.20	.01	496
1.01	1.01	23	.01	0.00	.01	0	1.01	13.55	167	.22	.20	.01	497
1.01	1.01	24	.01	0.00	.01	0	1.01	14.00	168	.22	.20	.01	498
1.01	1.01	25	.01	0.00	.01	0	1.01	14.05	169	.22	.20	.01	498
1.01	1.01	26	.01	0.00	.01	0	1.01	14.10	170	.22	.20	.01	498
1.01	1.01	27	.01	0.00	.01	0	1.01	14.15	171	.22	.20	.01	497
1.01	1.01	28	.01	0.00	.01	0	1.01	14.20	172	.22	.20	.01	498
1.01	1.01	29	.01	0.00	.01	0	1.01	14.25	173	.22	.20	.01	499
1.01	1.01	30	.01	0.00	.01	0	1.01	14.30	174	.22	.20	.01	499
1.01	1.01	31	.01	0.00	.01	0	1.01	14.35	175	.22	.20	.01	499
1.01	1.01	32	.01	0.00	.01	0	1.01	14.40	176	.22	.20	.01	499
1.01	1.01	33	.01	0.00	.01	0	1.01	14.45	177	.22	.20	.01	499
1.01	1.01	34	.01	0.00	.01	0	1.01	14.50	178	.22	.20	.01	499
1.01	1.01	35	.01	0.00	.01	0	1.01	14.55	179	.22	.20	.01	499
1.01	1.01	36	.01	0.00	.01	0	1.01	15.00	180	.22	.20	.01	499
1.01	1.01	37	.01	0.00	.01	0	1.01	15.05	181	.22	.20	.01	499
1.01	1.01	38	.01	0.00	.01	0	1.01	15.10	182	.22	.20	.01	499
1.01	1.01	39	.01	0.00	.01	0	1.01	15.15	183	.22	.20	.01	499
1.01	1.01	40	.01	0.00	.01	0	1.01	15.20	184	.22	.20	.01	499
1.01	1.01	41	.01	0.00	.01	0	1.01	15.25	185	.22	.20	.01	499
1.01	1.01	42	.01	0.00	.01	0	1.01	15.30	186	.22	.20	.01	499
1.01	1.01	43	.01	0.00	.01	0	1.01	15.35	187	.22	.20	.01	499
1.01	1.01	44	.01	0.00	.01	0	1.01	15.40	188	.22	.20	.01	499
1.01	1.01	45	.01	0.00	.01	0	1.01	15.45	189	.22	.20	.01	499
1.01	1.01	46	.01	0.00	.01	0	1.01	15.50	190	.22	.20	.01	499
1.01	1.01	47	.01	0.00	.01	0	1.01	15.55	191	.22	.20	.01	499
1.01	1.01	48	.01	0.00	.01	0	1.01	16.00	192	.22	.20	.01	499
1.01	1.01	49	.01	0.00	.01	0	1.01	16.05	193	.22	.20	.01	499
1.01	1.01	50	.01	0.00	.01	0	1.01	16.10	194	.22	.20	.01	499
1.01	1.01	51	.01	0.00	.01	0	1.01	16.15	195	.22	.20	.01	499
1.01	1.01	52	.01	0.00	.01	0	1.01	16.20	196	.22	.20	.01	499
1.01	1.01	53	.01	0.00	.01	0	1.01	16.25	197	.22	.20	.01	499
1.01	1.01	54	.01	0.00	.01	0	1.01	16.30	198	.22	.20	.01	499

1.01	6.125	55	.01	.00	.01	34	1.01	16.335	199	.00	.110	160	4111
1.01	6.150	56	.01	.00	.01	41	1.01	16.400	200	.00	.30	100	6074
1.01	6.175	57	.01	.00	.01	42	1.01	16.450	201	.00	.130	100	6084
1.01	6.200	58	.01	.00	.01	43	1.01	16.500	202	.00	.30	.00	6095
1.01	6.225	59	.01	.00	.01	44	1.01	16.550	203	.00	.30	.00	6105
1.01	6.250	60	.01	.00	.01	45	1.01	16.600	204	.00	.30	.00	6115
1.01	6.275	61	.01	.00	.01	46	1.01	16.650	205	.00	.30	.00	6125
1.01	6.300	62	.01	.00	.01	47	1.01	16.700	206	.00	.30	.00	6135
1.01	6.325	63	.01	.00	.01	48	1.01	16.750	207	.00	.30	.00	6145
1.01	6.350	64	.01	.00	.01	49	1.01	16.800	208	.00	.30	.00	6155
1.01	6.375	65	.01	.00	.01	50	1.01	16.850	209	.00	.30	.00	6165
1.01	6.400	66	.01	.00	.01	51	1.01	16.900	210	.00	.30	.00	6175
1.01	6.425	67	.01	.00	.01	52	1.01	16.950	211	.00	.30	.00	6185
1.01	6.450	68	.01	.00	.01	53	1.01	17.000	212	.00	.30	.00	6195
1.01	6.475	69	.01	.00	.01	54	1.01	17.050	213	.00	.30	.00	6205
1.01	6.500	70	.01	.00	.01	55	1.01	17.100	214	.00	.30	.00	6215
1.01	6.525	71	.01	.00	.01	56	1.01	17.150	215	.00	.30	.00	6225
1.01	6.550	72	.01	.00	.01	57	1.01	17.200	216	.00	.30	.00	6235
1.01	6.575	73	.01	.00	.01	58	1.01	17.250	217	.00	.30	.00	6245
1.01	6.600	74	.01	.00	.01	59	1.01	17.300	218	.00	.30	.00	6255
1.01	6.625	75	.01	.00	.01	60	1.01	17.350	219	.00	.30	.00	6265
1.01	6.650	76	.01	.00	.01	61	1.01	17.400	220	.00	.30	.00	6275
1.01	6.675	77	.01	.00	.01	62	1.01	17.450	221	.00	.30	.00	6285
1.01	6.700	78	.01	.00	.01	63	1.01	17.500	222	.00	.30	.00	6295
1.01	6.725	79	.01	.00	.01	64	1.01	17.550	223	.00	.30	.00	6305
1.01	6.750	80	.01	.00	.01	65	1.01	17.600	224	.00	.30	.00	6315
1.01	6.775	81	.01	.00	.01	66	1.01	17.650	225	.00	.30	.00	6325
1.01	6.800	82	.01	.00	.01	67	1.01	17.700	226	.00	.30	.00	6335
1.01	6.825	83	.01	.00	.01	68	1.01	17.750	227	.00	.30	.00	6345
1.01	6.850	84	.01	.00	.01	69	1.01	17.800	228	.00	.30	.00	6355
1.01	6.875	85	.01	.00	.01	70	1.01	17.850	229	.00	.30	.00	6365
1.01	6.900	86	.01	.00	.01	71	1.01	17.900	230	.00	.30	.00	6375
1.01	6.925	87	.01	.00	.01	72	1.01	17.950	231	.00	.30	.00	6385
1.01	6.950	88	.01	.00	.01	73	1.01	18.000	232	.00	.30	.00	6395
1.01	6.975	89	.01	.00	.01	74	1.01	18.050	233	.00	.30	.00	

5/10

1.01	9.35	115	.06	.05	.01	.98	1.01	21.35	259	.02	.02	.00	.42
1.01	9.40	116	.06	.05	.01	.99	1.01	21.40	260	.02	.02	.00	.42
1.01	9.45	117	.06	.05	.01	1.00	1.01	21.45	261	.02	.02	.00	.42
1.01	9.50	118	.06	.05	.01	1.00	1.01	21.50	262	.02	.02	.00	.42
1.01	9.55	119	.06	.05	.01	1.01	1.01	21.55	263	.02	.02	.00	.42
1.01	10.00	120	.06	.05	.01	1.01	1.01	22.00	264	.02	.02	.00	.42
1.01	10.05	121	.06	.05	.01	1.02	1.01	22.05	265	.02	.02	.00	.42
1.01	10.10	122	.06	.05	.01	1.03	1.01	22.10	266	.02	.02	.00	.42
1.01	10.15	123	.06	.05	.01	1.03	1.01	22.15	267	.02	.02	.00	.42
1.01	10.20	124	.06	.05	.01	1.04	1.01	22.20	268	.02	.02	.00	.42
1.01	10.25	125	.06	.05	.01	1.04	1.01	22.25	269	.02	.02	.00	.42
1.01	10.30	126	.06	.05	.01	1.04	1.01	22.30	270	.02	.02	.00	.42
1.01	10.35	127	.06	.05	.01	1.05	1.01	22.35	271	.02	.02	.00	.42
1.01	10.40	128	.06	.05	.01	1.05	1.01	22.40	272	.02	.02	.00	.42
1.01	10.45	129	.06	.05	.01	1.06	1.01	22.45	273	.02	.02	.00	.42
1.01	10.50	130	.06	.05	.01	1.06	1.01	22.50	274	.02	.02	.00	.42
1.01	10.55	131	.06	.05	.01	1.07	1.01	22.55	275	.02	.02	.00	.42
1.01	11.00	132	.06	.05	.01	1.07	1.01	23.00	276	.02	.02	.00	.42
1.01	11.05	133	.06	.05	.01	1.07	1.01	23.05	277	.02	.02	.00	.42
1.01	11.10	134	.06	.05	.01	1.08	1.01	23.10	278	.02	.02	.00	.42
1.01	11.15	135	.06	.05	.01	1.08	1.01	23.15	279	.02	.02	.00	.42
1.01	11.20	136	.06	.05	.01	1.09	1.01	23.20	280	.02	.02	.00	.42
1.01	11.25	137	.06	.05	.01	1.09	1.01	23.25	281	.02	.02	.00	.42
1.01	11.30	138	.06	.05	.01	1.09	1.01	23.30	282	.02	.02	.00	.42
1.01	11.35	139	.06	.05	.01	1.10	1.01	23.35	283	.02	.02	.00	.42
1.01	11.40	140	.06	.05	.01	1.10	1.01	23.40	284	.02	.02	.00	.42
1.01	11.45	141	.06	.05	.01	1.10	1.01	23.45	285	.02	.02	.00	.42
1.01	11.50	142	.06	.06	.01	1.10	1.01	23.50	286	.02	.02	.00	.42
1.01	11.55	143	.06	.06	.01	1.11	1.01	23.55	287	.02	.02	.00	.42
1.01	12.00	144	.06	.06	.01	1.11	1.02	0.00	288	.02	.02	.00	.42
SUM										33.15	29.99	3.16	60723.
										1.842	1.762	1.1	80.11 1719.481

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
3142.	699.	211.	211.	6073.
89.	20.	6.	6.	1720.
CMS	25.01	30.18	30.18	30.18
INCHES	6.25	7.66	7.66	7.66
MM	347.	418.	418.	418.
AC-FT	428.	516.	516.	516.
THOUS CU M				

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 1

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
314.	10.	21.	21.	6073.
9.	2.	1.	1.	172.
CMS	2.50	3.02	3.02	3.02
INCHES	6.32	7.66	7.66	7.66
MM	35.	42.	42.	42.
AC-FT	43.	52.	52.	52.
THOUS CU M				

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 2

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
314.	10.	21.	21.	6073.
9.	2.	1.	1.	172.
CMS	2.50	3.02	3.02	3.02
INCHES	6.32	7.66	7.66	7.66
MM	35.	42.	42.	42.
AC-FT	43.	52.	52.	52.
THOUS CU M				

1/10

STAGE	650.70	651.00	651.50	652.00	652.50	653.00	653.50	654.10	656.00
FLOW	0.00	10.00	40.00	80.00	130.00	190.00	260.00	360.00	770.00
SURFACE AREA	0.	5.	8.	10.					
CAPACITY	0.	51.	109.	283.					
ELEVATION	620.	651.	660.	680.					
CREL	650.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPRID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FLEVL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CARLA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAM DATA									
TOPEL	654.1	3.0	1.5	342.					
CORD	3.0	1.5	342.						
DAMWID	342.								
CREST LENGTH AT OR BELOW ELEVATION	25.	200.	342.	380.	800.				
	654.1	655.0	656.6	660.0	680.0				
STATION	2.	PLAN 1.	RATIO 1						

PEAK OUTFLOW IS 153. AT TIME 16.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	153.	66.	21.	21.	5962.
CMS	4.	2.	1.	1.	169.
INCHES	2.36	2.36	2.36	2.36	2.36
MM	59.90	75.25	75.25	75.25	75.25
AC-FT	33.	41.	41.	41.	41.
THOUS. CU M	40.	51.	51.	51.	51.

STATION 2. PLAN 1. RATIO 2

PEAK OUTFLOW IS 348. AT TIME 15.02 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	348.	134.	41.	41.	11248.
CMS	10.	4.	1.	1.	338.
INCHES	4.79	5.94	5.94	5.94	5.94
MM	121.61	150.81	150.81	150.81	150.81
AC-FT	66.	82.	82.	82.	82.
THOUS. CU M	82.	101.	101.	101.	101.

8/10

STATION 2. PLAN 1, RATIO 3

PEAK OUTFLOW IS 688. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	688.	202.	62.	62.	17963.
CMS	19.	6.	2.	2.	509.
INCHES		7.24	8.93	8.93	
MM		183.79	226.72	226.72	
AC-FT		100.	124.	124.	
THOUS CU M		124.	153.	153.	

STATION 2. PLAN 1, RATIO 4

PEAK OUTFLOW IS 1437. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1437.	340.	104.	104.	30004.
CMS	41.	10.	3.	3.	850.
INCHES		12.16	14.91	14.91	
MM		308.83	378.71	378.71	
AC-FT		169.	207.	207.	
THOUS CU M		208.	255.	255.	

STATION 2. PLAN 1, RATIO 5

PEAK OUTFLOW IS 3110. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3110.	687.	209.	209.	60117.
CMS	88.	19.	6.	6.	1702.
INCHES		24.57	29.87	29.87	
MM		624.06	758.78	758.78	
AC-FT		341.	414.	414.	
THOUS CU M		420.	511.	511.	

9/10

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				.10	.20	.30	.50	1.00
HYDROGRAPH AT	1	.26 .67	1	314. 8,290	628. 17,791	942. 26,691	1571. 44,481	3142. 88,961
	2	.26 .67	1	153. 4,321	348. 9,861	688. 19,481	1437. 40,691	3110. 88,061

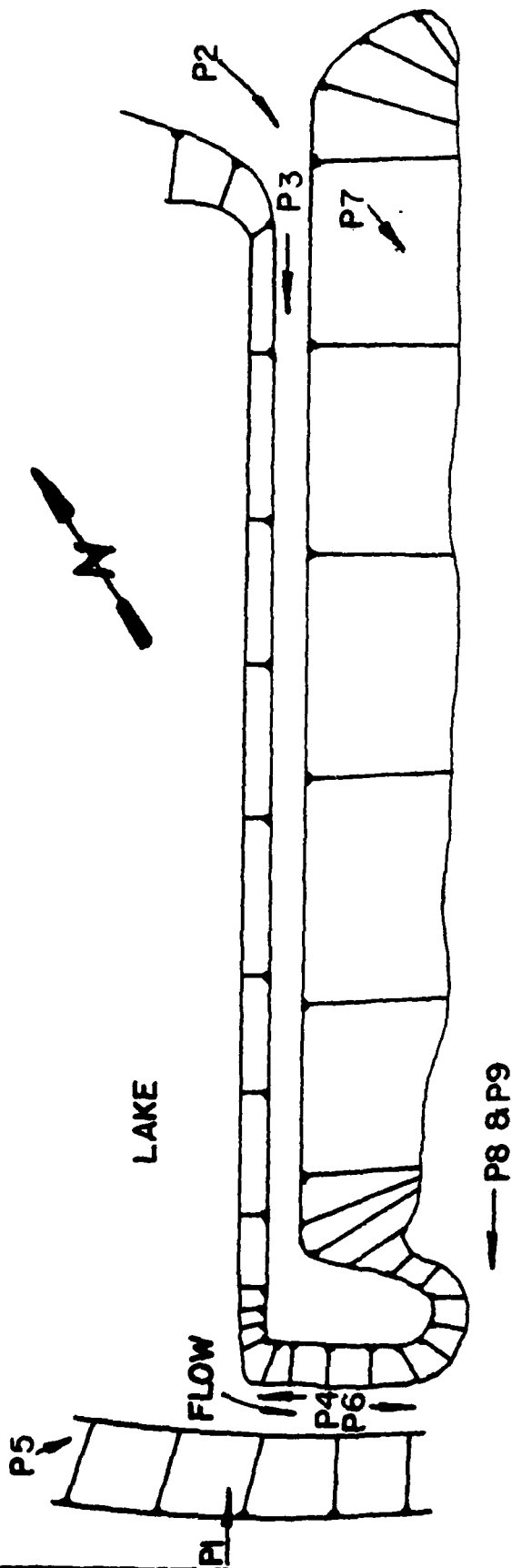
10/0

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		650.70		650.70		654.10			
OUTFLOW		51.		51.		70.			
		0.		0.		360.			
RATIO OF PPE	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS		TIME OF FAILURE HOURS	
	.10	652.69	0.00	62.	153.	0.00	16.00	0.00	0.00
	.20	654.03	0.00	69.	348.	0.00	15.92	0.00	0.00
	.30	654.86	.76	74.	688.	.67	15.83	0.00	0.00
	.50	655.60	1.50	79.	1437.	1.17	15.75	0.00	0.00
1.00	656.56	2.46	85.	3110.	5.17	15.75	0.00	0.00	0.00

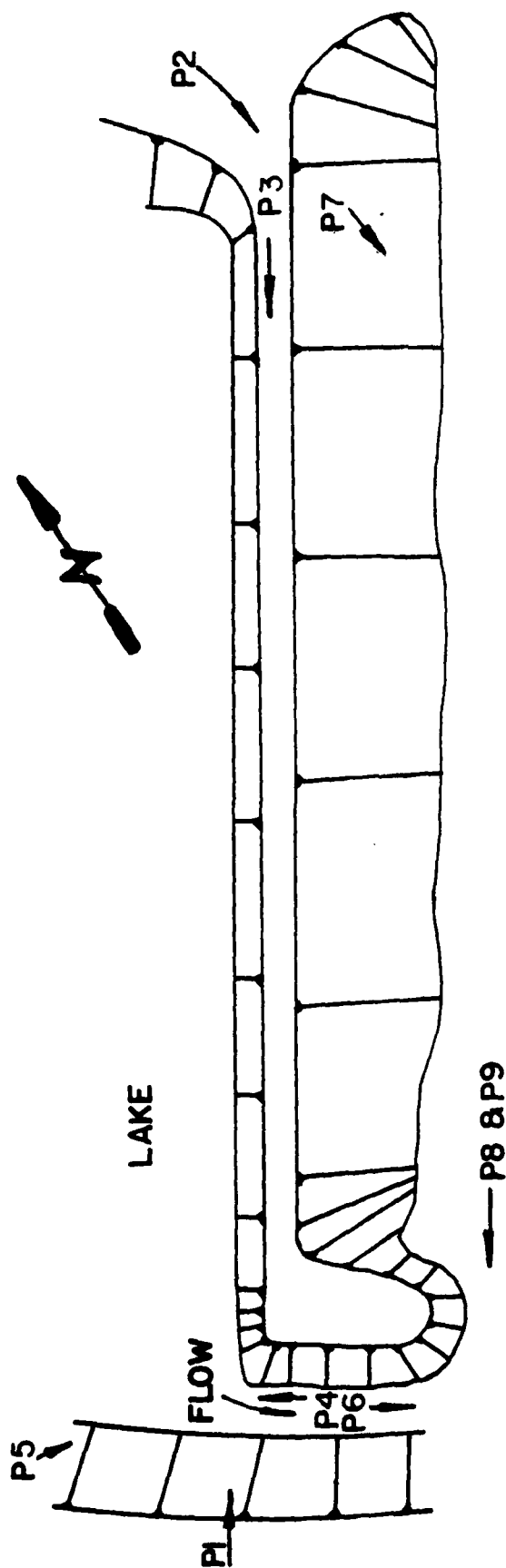
APPENDIX C

PHOTOGRAPHS



P-INDICATES PHOTO LOCATION

HARMAN'S FARM POND
PHOTO INDEX



C-1

HARMAN'S FARM POND
PHOTO INDEX

P-INDICATES PHOTO LOCATION



Photograph No. 2
Downstream slope.



Photograph No. 3
View of crest from left abutment.



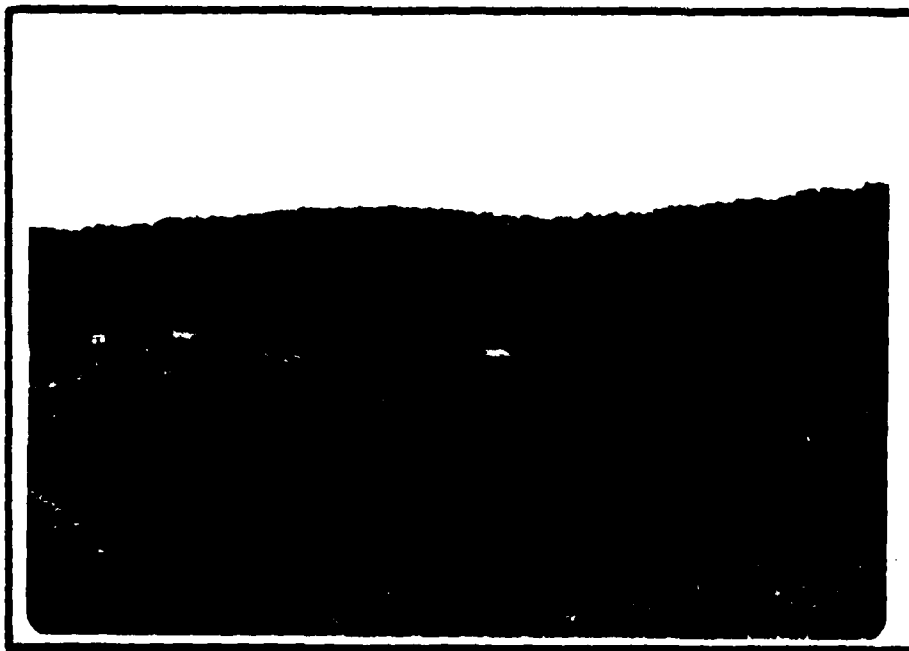
Photograph No. 4
Spillway approach channel.



Photograph No. 5
Spillway exit channel.



Photograph No. 6
Spillway discharge channel.



Photograph No. 7
Immediate downstream area.



Photograph No. 8
Spillway exit channel beyond toe of dam.



Photograph No. 9
Spillway exit channel beyond toe of dam.

DATE
FILMED
- 8